

What is claimed is:

1 1. An electrode material comprising a surface/chemically modified positive
2 electrode (cathode) material, wherein the surface/chemical modification is a ceramic.

1 2. The composition of claim 1, wherein the surface/chemical modification is
2 selected from the group consisting of $\text{Li}_x\text{Ni}_{1-y}\text{M}_y\text{O}_2$, where $0 \leq x \leq 1$, $0 \leq y \leq 1$, and M
3 = Mg, Al, Ti, V, Cr, Fe, Co, Cu, Zn, and Ga; Al_2O_3 ; Cr_2O_3 ; MgO ; $\text{Al}_{2-y}\text{Mg}_y\text{O}_{3-0.5y}$
4 where $0 \leq y \leq 2$; $\text{Li}_{1+x}\text{Mn}_{2-x-y}\text{M}_y\text{O}_4$ where $0 \leq x \leq 0.33$, $0 \leq y \leq 2$ and M = Mg, Al, Ti,
5 V, Cr, Fe, Co, Ni, Cu and Zn; $\text{Zr}_{1-y}\text{M}_y\text{O}_{2-y}$ where $0 \leq y \leq 1$ and M = Mg, Ca; $\text{Zr}_{1-y}\text{M}_y\text{O}_{2-}$
6 $0.5y$ where $0 \leq y \leq 1$ and M = Sc, Y; and a combinations thereof.

1 3. The composition of claim 1, wherein the positive electrode (cathode) material is
2 selected from the group consisting of LiCoO_2 , LiMn_2O_4 , $\text{LiNi}_{1-y}\text{Co}_y\text{O}_2$ where $0 \leq y \leq 1$
3 and $\text{LiMn}_{1-y}\text{M}_y\text{O}_2$ where M = Cr and Al and $0 \leq y \leq 1$, and $\text{Li}_{1+x}\text{Mn}_{2-x-y}\text{M}_y\text{O}_{4-z+\delta}\text{X}_z$
4 where $0 \leq x \leq 0.33$, $0 \leq y \leq 1$, $0 \leq \delta \leq 0.5$, M = Mg, Al, Ti, V, Cr, Fe, Co, Ni, Cu and
5 Zn, and X = F and S.

1 4. The composition of claim 1, wherein the positive electrode (cathode) material is
2 LiMn_2O_4 .

1 5. The composition of claim 1, wherein the positive electrode (cathode) material is
2 LiCoO_2 .

1 6. The composition of claim 1, wherein the surface/chemical modification material
2 is $\text{Li}_x\text{Ni}_{1-y}\text{Co}_y\text{O}_2$, where $0 \leq x \leq 1$; $0 \leq y \leq 1$.

1 7. The composition of claim 1, wherein the surface/chemical modification material
2 is Al_2O_3 .

1 8. The composition of claim 1, wherein the surface/chemical modification material
2 is MgO .

1 9. The composition of claim 1, wherein the surface/chemical modification material
2 is MgAl_2O_4 .

1 10. The composition of claim 1, wherein the surface/chemical modification material
2 is $\text{Li}_{1.05}\text{Mn}_{1.9}\text{Ni}_{0.05}\text{O}_4$.

1 11. The composition of claim 1, wherein the surface/chemical modification material
2 is Cr_2O_3 .

1 12. An electrode material comprising a LiMn_2O_4 spinel oxide having been
2 surface/chemically modified with a surface/chemical modification material selected
3 from the group consisting of $\text{Li}_x\text{Ni}_{1-y}\text{Co}_y\text{O}_2$, where $0 \leq x \leq 1$; $0 \leq y \leq 1$; Al_2O_3 ; Cr_2O_3 ;
4 MgO ; MgAl_2O_4 ; and a combinations thereof.

1 13. The composition of claim 11, wherein the surface/chemical modification
2 material is $\text{Li}_x\text{Ni}_{1-y}\text{Co}_y\text{O}_2$, where $0 \leq x \leq 1$; $0 \leq y \leq 1$.

1 14. The composition of claim 11, wherein the surface/chemical modification
2 material is Al_2O_3 .

1 15. The composition of claim 11, wherein the surface/chemical modification
2 material is MgO .

1 16. The composition of claim 11, wherein the surface/chemical modification
2 material is MgAl_2O_4 .

1 17. The composition of claim 11, wherein the surface/chemical modification
2 material is Cr_2O_3 .

1 18. An electrode material comprising a LiCoO_2 layered oxide having been
2 surface/chemically modified with a surface/chemical modification material selected
3 from the group consisting of Al_2O_3 ; Cr_2O_3 ; MgO ; MgAl_2O_4 ; $\text{Li}_{1+x}\text{Mn}_{2-x-y}\text{M}_y\text{O}_4$ where 0
4 $\leq x \leq 0.33$, $0 \leq y \leq 2$ and $\text{M} = \text{Ni}$ or Co ; and a combinations thereof.

1 19. The composition of claim 17, wherein the surface modification material is
2 Al_2O_3 .

1 20. The composition of claim 17, wherein the surface modification material is
2 $\text{Li}_{1.05}\text{Mn}_{1.9}\text{Ni}_{0.05}\text{O}_4$

1 21. An electrode material preparation method comprising:
2 supplying a LiMn_2O_4 spinel oxide electrode material;
3 mixing the LiMn_2O_4 spinel oxide electrode material with a surface/chemical
4 modification material selected from a group consisting of $\text{Li}_x\text{Ni}_{1-y}\text{Co}_y\text{O}_2$, where $0 \leq x \leq$
5 1 ; $0 \leq y \leq 1$; Al_2O_3 ; Cr_2O_3 ; MgO ; MgAl_2O_4 ; and combinations thereof; and
6 heat-treating the mixture to prepare a surface/chemically modified LiMn_2O_4
7 electrode material.

1 22. The method of claim 20, wherein the heat-treating is performed at a temperature
2 in the approximate range of 100°C to 1000°C .

1 23. The method of claim 20 wherein the heat-treating is performed for
2 approximately 1 to 24 hours.

1 24. The method of claim 20, wherein the surface/chemical modification material is
2 in the approximate range of 1 to 20 weight percent of the surface/chemically modified
3 LiMn_2O_4 electrode material.

1 25. An electrode material comprising a surface/chemically modified LiMn_2O_4
2 spinel oxide said electrode material prepared by a process comprising:

3 a) refluxion of a precursor solution in glacial acetic acid, wherein the precursor
4 is selected from a group consisting of Li_xCoO_2 , $\text{LiCo}_{0.5}\text{Ni}_{0.5}\text{O}_2$, and Al_2O_3 ;

5 b) preparing a precursor solution in water, wherein the precursor is selected
6 from a group consisting of Al_2O_3 ; Cr_2O_3 ; MgO , and MgAl_2O_4 ;

7 c) dispersing LiMn_2O_4 spinel oxide in the precursor solution; and

8 d) heating the dispersed LiMn_2O_4 spinel oxide to approximately 100 to 500
9 degrees C; and

10 e) firing the heated dispersed LiMn_2O_4 spinel oxide at 500 to 900 degrees C.

1 26. A method of preparing an electrode material for lithium-ion batteries
2 comprising:

3 supplying a LiCoO_2 layered oxide electrode material;

4 mixing the LiCoO_2 layered oxide electrode material with a surface/chemical
5 modification material selected from a group consisting of Al_2O_3 ; Cr_2O_3 ; MgO ,
6 MgAl_2O_4 ; $\text{Li}_{1+x}\text{Mn}_{2-x-y}\text{M}_y\text{O}_4$ where $0 \leq x \leq 0.33$, $0 \leq y \leq 2$ and $\text{M} = \text{Ni}$ or Co ; and
7 combinations thereof; and

8 heat-treating the mixture to prepare a surface/chemically modified LiCoO_2
9 electrode material.

1 27. The method of claim 23, wherein the heat-treating is performed at a temperature
2 in the approximate range of 100°C to 1000°C .

1 28. The method of claim 23 wherein the heat-treating is performed for
2 approximately 1 to 24 hours.

1 29. The method of claim 25, wherein the surface/chemical modification material is
2 in the approximate range of 1 to 20 weight percent of the surface/chemically modified
3 LiCoO_2 electrode material.

1 30. An electrode material comprising a surface/chemically modified LiCoO_2
2 layered oxide said electrode material prepared by a process comprising:

3 a) refluxion of a precursor solution in glacial acetic acid, wherein the precursor
4 is selected from a group consisting of Al_2O_3 ; Cr_2O_3 ; MgO , MgAl_2O_4 ; $\text{Li}_{1+x}\text{Mn}_{2-x-y}\text{M}_y\text{O}_4$
5 where $0 \leq x \leq 0.33$, $0 \leq y \leq 2$ and $\text{M} = \text{Ni}$ or Co ;

6 b) preparing a precursor solution in water, wherein the precursor is selected
7 from a group consisting of Al_2O_3 ; Cr_2O_3 ; MgO , and MgAl_2O_4 ;

8 c) dispersing LiCoO_2 layered oxide in the precursor solution; and

9 d) heating the dispersed LiCoO_2 layered oxide to approximately 100 to 500
10 degrees C; and

11 e) firing the heated dispersed LiCoO_2 layered oxide at 500-900 degrees C.